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## ABSTRACT

It is proposed that the construction industry collaborate with educational practitioners and administrators to establish the objectives of construction engineering programs. Other recommendations are that the construction industry assume direct teaching responsibility for designated areas of instruction; provide program support, such as work opportunities and internships; and periodically review the operation of construction engineering programs, providing evaluations and suggestions to the program administrators where appropriate. (MLH)

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WHAT THE CONSTRUCTION INDUSTRY CAN CONTRIBUTE  
TO ENGINEERING EDUCATION

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## INTRODUCTION

The authors welcome the opportunity to present their views on this timely subject. The importance of construction education for employment levels ranging from craft apprentice to company president has become increasingly apparent. The growing needs of our complex society are placing ever-greater demands on the construction industry. The industry, in responding to this challenge, will require better technical and managerial skills from its future employees. Traditionally, the construction industry has turned to the engineering schools as its primary source of professionally-trained personnel. In so doing, it has become one of the major employers of engineering graduates.

It is the wish and intent of the authors that the historical bonds between the construction industry and the engineering schools continue to exist. Hopefully, they will become even stronger. If this goal is to be realized, a continuing dialogue between the construction industry and the educational institutions must be established and maintained. It is hoped that this paper will contribute to such a dialogue.

The professional constructor of today must have a wide range of skills. Many of these, for their optimum development, should be structured on an adequate educational foundation. The educational

needs of the constructor encompass several technical areas which the engineering schools have traditionally included in their curricula, but they also extend far beyond the solely technical areas. The professional constructor, much like the professional engineer who engages in private practice, must extend his total competency if he is to function effectively within our economic, legal, political and societal environment. The response of the engineering schools to the evolving requirements of the construction industry has appeared, to many who work in the industry, to be disappointingly slow.

It is conceded that any formal undergraduate program of engineering education, once a 4-year time constraint has been introduced, must involve many trade-offs between competing areas of instruction. The determination of these trade-offs should, in the opinion of the authors, involve the industry employers as well as the professional educators. Engineering curricula, almost without exception, have failed to give adequate recognition to the educational needs of the construction industry. This defect is increasingly apparent as the industry's interests become broader in scope and as less emphasis is given to the "drawing-board" stage of design activity. There are hopeful indications that this situation is being recognized by the engineering schools, some of which are revising their curricula so as to better

prepare their graduates for actual construction practice. The construction industry supports such moves, as will be evidenced by documentation supplied in this paper.

### HISTORICAL REVIEW

The construction industry has a laudable record of involvement in construction education. This involvement predates that of the majority of those educational institutions which now offer formal construction-oriented programs. The industry's interest in education encompasses students in junior high schools as well as those enrolled in various colleges and universities. The industry has made a wide range of continuing education programs available to its employees. It has been involved in the development, field testing, and teaching of apprentice programs. Its educational activities have included the instigation and funding of research, the formulation of construction education goals and recommended construction curricula, the preparation of career guidance literature, the development of training programs, the publication of various books and manuals, and the sponsorship of numerous seminars and short courses.

The major educational activities of the Associated General Contractors of America will now be summarized. The intent is to illustrate the

industry's long-standing concern with education. In so doing, it is recognized that several other industry organizations have comparable records of educational involvement.

The Associated General Contractors of America operates as a national organization in support of over 100 state or local chapters made up of its 8,500 contractor company members. Its educational interests at the national level are directed through its Construction Education Committee, through several joint committees with education groups, and through an Education and Research Foundation. The significant educational activities of AGC include the following:

- beginning in 1964, a Construction Education Bulletin has been distributed to AGC members and to other interested persons. This Bulletin, together with supplementary memoranda, records various educational activities which are of interest to the construction industry and construction educators.
- AGC has assumed the responsibility of providing continuing education opportunities to acquaint its professional contractor members with the most efficient methods of

company management. Seminars and short courses which are directed towards specific educational areas have been sponsored by AGC, both at the national level and at chapter levels. Some 120 such programs were conducted in 1974, including five nationally-sponsored seminars. AGC intends to help its members respond to changes in the construction delivery process, while conducting their business in an efficient and profitable manner.

- many young people at the junior high school level now have the opportunity to explore the construction industry through the "World of Construction", a year-long substitute for the traditional industrial arts class. Students learn the various phases of construction methods and levels of management. They can then apply this knowledge throughout their lives, regardless of the occupations they ultimately choose. This curriculum was developed at Ohio State University with input from AGC members.
- construction industry organizations have funded a feasibility study for construction career exploration at the high school

level. This study was completed in 1974 by the same group at Ohio State University which prepared the successful "World of Construction" programs. Funding sources for implementation of a high school program based on the feasibility study are now being explored.

- AGC has been active at the high school level in offering career guidance for those who are contemplating a career in construction. A 16 mm AGC color film entitled, "To Build A Future" explains the various routes by which a person can enter the nation's largest industry. AGC brochures such as "Construction Opportunities Unlimited" have been supplied to high schools, as have speakers from industry to help provide guidance to potential constructors. A 60-second, public service television announcement was produced last fall and will be distributed to over 200 commercial stations. This announcement will urge high school students to stay in school and get their diplomas, then become a part of the world of construction.

- at the university level, AGC seeks assurance that graduates of schools with construction curricula will



be properly prepared to enter the industry and ultimately to assume responsible positions in the industry. A joint committee functions with representation from AGC, the Associated Schools of Construction, the American Institute of Constructors, and the American Society for Engineering Education. This joint committee of industry and academic leaders promotes quality education to meet the requirements of the construction industry. At its next meeting, the group will be expanded to include mechanical and electrical representation from the construction industry.

- AGC encourages its members to provide summer employment for construction-oriented students and faculty. "Work-study", "co-op" and "internship" arrangements have also been encouraged as a way of providing real-life experience for faculty and students. AGC is currently exploring ways whereby students who are enrolled in university-level construction curricula may engage in various craft activities during brief work periods, while avoiding the requirement that they first join a labor union.

- the AGC Education and Research Foundation was established

in 1968 to support construction education and to foster construction research. A scholarship program is administered by the Foundation and funded by the Consulting Constructors Council of America. This provides scholarships to deserving students in the amount of \$1,000 per year, renewable for up to four years. Over \$140,000 has been committed for this purpose since 1969. The Foundation has also awarded a limited number of research grants. In March of this year, the Foundation provided \$34,225 to Iowa State University for the second stage of a national supervisory training program. This study will develop the course specifications for ten specific courses in the program. In 1974, the Foundation established the Research Advisory Council to assist the Foundation in developing and maintaining an expanded program of construction industry research.

- the Construction Education Directory, first issued in 1969 and updated in 1974, lists over 80 colleges and universities throughout the country with construction-related educational curricula. The Directory is available to AGC members, and through its chapters has been widely distributed to high school

counselors. It includes both undergraduate and graduate levels of education, and it encompasses two-year and four-year technology programs as well as programs which are administered by architectural, engineering, construction, and industrial management departments of universities.

- a network of nearly 30 AGC student chapters provides the college-level construction student with a medium for implementing ideas and maintaining essential contact with the industry.
- AGC was deeply involved in ASCE's 1974 Conference on Civil Engineering Education, held at Ohio State University. A major segment of this conference was devoted to the needs for construction education and an evaluation of the adequacy of current educational programs.
- the AGC Construction Education Committee has been active in encouraging the development of construction education curricula at the university level. It has recently revised its "Educational Goals and Recommended Construction Curricula for the Construction Industry" to include a

a combined set of guidelines which apply to building construction as well as to highway and heavy construction. Specific coverages within each subject area are deliberately excluded from this document. In this way, the universities are encouraged to tailor their programs to meet the particular needs of their area and to utilize the educational skills of their faculty. The Construction Education Committee is presently involved in exploring mechanisms for the accreditation of professional programs for construction education.

Viewed from another angle, the educational activities in which AGC is currently engaged can be grouped into three broad categories. The first of these is directed towards providing information as to sources of construction education; the Construction Education Bulletin and the Construction Education Directory are prime examples of this activity. Next, AGC provides direct aid in the form of scholarships and assistance in finding summer employment opportunities to persons who seek to further their construction education. Finally, AGC supplies source material for construction education in the form of sponsored seminars, workshops, training programs, film strips, cassettes, publications, speakers, etc.

These national educational activities of AGC are further strengthened through the efforts of its several chapters and its member companies. The unifying theme to AGC's educational activities is an emphasis on the educational development of those persons who intend to pursue professional careers within the construction industry.

### THE FUTURE

The construction industry looks to a more active role in the identification of educational objectives for construction engineering programs. Its claim to this role is based on its recorded involvement and concerns with construction education, as well as upon its acknowledged position as a major employer of the graduates of engineering schools. The construction industry is uniquely capable of supplying the engineering schools with explicit statements as to the performance standards which it expects from graduating engineers who seek careers in construction.

It is therefore proposed that the educational objectives of construction engineering programs should be arrived at collaboratively, through joint discussions between educational administrators and construction practitioners, rather than being established unilaterally. The next step would involve the structuring of curricula in accor-

dance with these objectives, and would become a primary responsibility of the professional educators. However, a continuing exchange of views should be maintained throughout this process and throughout the operation of the program. Various mechanisms for effecting this exchange have been proposed and, in some cases, have been implemented. A Joint Advisory Committee with significant industry representation offers a hopeful potential for success.

The involvement of the construction industry in the educational process should not be limited to participation in identifying educational objectives and to evaluations of construction engineering curricula which are subsequently developed. Rather, appropriate elements from the expertise of practicing constructors should be incorporated into the instructional material and methods. The students should be exposed, to whatever extent is possible, to a "real world" environment in which their decisions are based on state-of-the-art data, economic and sociological considerations, as well as upon the theoretical concepts which have traditionally been taught in the classroom. Properly handled, this can bring a new challenge and excitement to the educational process. Construction practitioners can be brought into the classroom and significant teaching responsibilities assigned to them within their

areas of expertise. Construction students and faculty can be brought into the offices of construction contractors, or placed directly on the job site. Construction experience, acquired either through summer employment or through a formal work-study program, can be integrated with classroom instruction to the benefit of the student.

It is recognized that many practical difficulties must be overcome before all of the foregoing proposals can be implemented in depth. This in no way detracts from their importance. The engineering schools should be asked to accept the employers of engineering graduates as a significant voice in the structuring and implementation of formal educational programs. The people from industry should, in turn, be asked to assume significant responsibilities and personal involvement in this program thus established. Lip service to these concepts will not suffice; the educational partnership must exist in fact, rather than in fantasy.

Specific areas in which the construction industry can be expected to contribute to construction engineering education will now be summarized:

- collaborate with professional educators in identifying

ranked objectives, preferably expressed in terms of desired skills of graduating engineers, for construction engineering programs.

- periodically review the operation of construction engineering programs, providing evaluations and suggestions to the program administrators where appropriate. As noted earlier, this might be accomplished through an Industry Advisory Council, or its equivalent.
- assume direct teaching responsibility for designated areas of instruction, both within the classroom and outside of it. This involvement may include guest lecturers, seminars, etc., but should not be confined to these. A continuing educational involvement for selected industry practitioners, with direct teaching responsibility for a significant block of instructional material, could improve the rapport between the industry and the engineering schools.
- program support in such areas as work opportunities for faculty and students, "co-op" programs, internships, scholarships and supplementary funding, program publicity



at high school levels, sponsorship of student societies and activities, "Construction Day" programs which recognize students already in the program, etc.

In closing, the authors wish to again express their pleasure at being afforded this forum to present their views. The invitation to submit this paper is, in itself, an encouraging sign of a long-awaited change in attitudes. The construction industry and the engineering schools are bound together by many common ties. The past now lies behind us. Our joint future will be largely what we want to make of it.